

THE RELATIONSHIP BETWEEN ENERGY INTAKE FROM THE FREE NUTRITIOUS MEAL (MBG) PROGRAM AND ENERGY ADEQUACY LEVELS AMONG ADOLESCENTS AT MAN 2 PAREPARE CITY

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Abstract

Background: The MBG is a school-based nutrition intervention designed to help meet students' energy requirements. This study aimed to analyze the contribution of energy intake from the MBG Program to the level of daily energy adequacy among students at MAN 2 Kota Parepare, while considering students' dietary habits.

Methods: This study used an observational analytic design with a *cross-sectional* approach involving 122 eleventh-grade students at MAN 2 Kota Parepare, selected using the Slovin formula. Data were collected using questionnaires, two non-consecutive 24-hour food recalls to assess daily energy intake, a *Food Frequency Questionnaire* (FFQ) to describe dietary habits, and anthropometric measurements using BMI-for-age (BMI/A) to determine nutritional status. Data were analyzed using the *Chi-Square* test to examine associations between variables. **Results:** The univariate analysis showed that most students had energy intake from the MBG Program in the adequate category (67.2%), adequate daily energy intake (76.2%), normal nutritional status (67.2%, 82 students), and dietary habits in the adequate category (55.7%). The *Chi-Square* test showed a statistically significant association between the contribution of energy intake from the MBG Program and students' daily energy adequacy ($p = 0.028$). Specifically, 34.4% of students with a low MBG energy contribution (<25%) had inadequate daily energy intake, whereas 88.1% of students with a moderate MBG energy contribution (25–35%) achieved adequate daily energy intake. **Conclusion:** The MBG Program was shown to be an effective school-based nutrition intervention in supporting students' daily energy adequacy. However, maintaining optimal daily energy adequacy is also influenced by independent food consumption patterns and dietary habits outside school.



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Introduction

Adolescents are an age group undergoing a transitional phase characterized by rapid physical, psychosocial, and cognitive growth and development (1). This phase directly increases their energy and nutrient requirements to support learning activities, physical activity, and various physiological functions. However, during this critical period of growth and development, Indonesia faces a substantial challenge in the form of the *triple burden of malnutrition* among adolescents, namely the coexistence of undernutrition (*underweight*), overnutrition (obesity), and micronutrient deficiencies such as anemia (2). According to data from the Ministry of Health of the Republic of Indonesia through the 2023 Indonesian Health Survey (SKI), the prevalence of anemia among adolescents aged 15–24 years was reported at 15.5%, while the prevalence of obesity among individuals aged over 18 years reached 23.4%. This double burden of malnutrition represents a significant public health challenge among Indonesian adolescents and is exacerbated by nutrition transition associated with urbanization and shifts in adolescents' daily dietary patterns toward less balanced food consumption (3).

Although anemia as a micronutrient deficiency is often highlighted as a major nutritional problem among adolescents, other nutritional problems, including *underweight*, *overweight*, and obesity, are also associated with an imbalance between energy intake and the body's requirements. Energy intake is derived primarily from macronutrients, particularly carbohydrates, proteins, and fats, which play important roles in meeting energy requirements and supporting adolescent growth and development. Long-term discrepancies between energy intake and energy requirements may increase the risk of nutritional status problems (4). Therefore, the government has developed the Free Nutritious Meal Program (*Program Makan Bergizi Gratis*, MBG) as an intervention to support the nutritional needs of school-aged children and adolescents. According to the guidelines of the National Nutrition Agency, MBG provision for students at the junior and senior secondary school levels is targeted to meet approximately 30–35% of daily energy requirements through one main meal with a nutritional composition adjusted to the needs of the target population. However, the effectiveness of the 30–35% energy contribution provided by the MBG Program cannot be evaluated in isolation. The success of this government intervention is strongly influenced by and closely interacts with students' overall dietary habits outside the school environment. Current urban adolescent lifestyles are particularly vulnerable to unhealthy eating behaviors, such as skipping breakfast, frequent consumption of fast food, and snacking on foods that are high in calories but low in nutritional value (5).

If students maintain poor dietary habits at home, the energy contribution of the MBG Program may be affected. The energy provided through MBG at school may be insufficient to address nutritional deficits resulting from frequent meal skipping at home. Conversely, it

may contribute to excessive daily energy intake when combined with excessive calorie consumption outside school (6). At the local level, Parepare City, as one of the urban centers in South Sulawesi, faces similar nutrition transition challenges that may influence dietary behaviors among school-aged adolescents. Nevertheless, specific data on the health profile and nutritional status of school-aged adolescents in this area remain limited. MAN 2 Kota Parepare was selected as the research site because it is one of the largest senior secondary schools in Parepare City, with a substantial student population and diverse socioeconomic backgrounds. These characteristics make the school a relevant setting for assessing variations in the nutritional conditions of urban adolescents. In addition, the school is one of the educational institutions in the area that has implemented the MBG Program to reach hundreds of its students (7).

The urgency of conducting this study is further supported by the need for empirical evaluation of the MBG Program. Although the MBG Program has reached hundreds of students at MAN 2 Kota Parepare, the effectiveness of its energy contribution to students' nutritional adequacy has not been empirically evaluated, particularly given the lack of published data on the nutritional status of students at the school. Without a measurable evaluation, policymakers have limited evidence to determine whether the daily MBG portion has achieved its intended nutritional objectives or whether its contribution is influenced by students' independent dietary patterns at home. Therefore, this study aimed to comprehensively analyze the contribution of energy intake from the MBG Program to the level of energy adequacy among students at MAN 2 Kota Parepare while considering their daily dietary habits. The findings are expected to provide important empirical evidence for improving similar school-based nutrition intervention programs in the future (8).

Materials and Methods

This study employed an observational analytic design with a *cross-sectional* approach to analyze the contribution of energy intake from the Free Nutritious Meal Program (MBG) to students' daily energy adequacy at MAN 2 Kota Parepare. The study was conducted from July to August 2026. The study population consisted of all eleventh-grade students at MAN 2 Kota Parepare, totaling 176 students. Using the Slovin formula with a 5% margin of error, the minimum sample size was 122 respondents. To minimize selection bias and ensure sample representativeness, students were selected from the eleventh-grade population using *Proportional Stratified Random Sampling*, in which respondents from each parallel class were randomly selected proportionally. Eleventh-grade students were selected because they were considered to have relatively stable school attendance and learning patterns. They had adapted to the school environment more fully than tenth-grade students and were not yet occupied with graduation examinations and related preparations, as were twelfth-grade students.

Primary data were collected through face-to-face interviews conducted by the researchers. Total daily energy intake was assessed using the *24-Hour Food Recall* method on two non-consecutive days, consisting of one school day when the MBG meal was provided and one school holiday. This approach was used to minimize variation in individual daily food intake. To reduce recall bias, interviews employed the *multiple-pass recall* technique and were supported by the Indonesian Ministry of Health's Food Photo Album to improve the accuracy of portion-size estimation. The energy content of all foods consumed was calculated using nutrition analysis software based on the Indonesian Food Composition Table (TKPI). Students nutritional status was determined using BMI-for-age (BMI/A) based on measurements of body weight and height. Body weight was measured using a digital scale, while height was measured using a *microtoise*. Anthropometric data were then converted into standard deviation scores (*Z-scores*) for BMI-for-age based on the classification standards stipulated in Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2020. Meanwhile, students' dietary habits during the previous month were assessed using a semi-quantitative *Food Frequency Questionnaire* (FFQ) that had been tested for validity and reliability in adolescent populations.

Table 1 Operational definitions of variables

Variable	Operational Definition	Instrument	Measurement / Categorization	Data Scale
MBG Energy Contribution	Percentage of energy (kcal) contributed by the school MBG meal to the total daily energy requirements of the individual.	24-Hour Food Recall sheet & TKPI software.	- Low: < 25% requirements - Moderate: 25%–35% requirements - High: > 35% requirements	Ordinal
Daily Energy Adequacy Level	Percentage of total daily energy intake (school + outside school) compared to the Individual Dietary Allowance (AKG).	24-Hour Food Recall sheet (2 days) & AKG age groups.	- Low: < 80% RDA - Adequate: 80%–110% RDA - Excess: > 110% RDA	Ordinal
Nutritional Status (BMI-for-age)	Clinical condition of the body based on BMI-for-age comparison.	Calibrated digital scale (SECA) & microtoise.	Z-score classifications (PMK No. 2/2020): - Thinness: -3 SD to < -2 SD - Normal: -2 SD to +1 SD	Ordinal

Variable	Operational Definition	Instrument	Measurement / Categorization	Data Scale
Eating Habits	General overview of food variety and regular meal frequency in daily life.	Food Frequency Questionnaire (FFQ).	- Overweight: > +1 SD to +2 SD FFQ score percentages: - Low: < 50% - Moderate: 50%–75% - Good: > 75%–100%	Ordinal

The data processing stages involved computerized editing, coding, entry, and cleaning. Data analysis was conducted in two stages: univariate analysis to generate frequency distributions and percentages regarding respondent characteristics (age, gender), MBG energy intake, daily energy adequacy levels, nutritional status, and students' eating habits; and bivariate analysis using the Chi-Square test to examine the significance of the relationship between the energy contribution from the MBG program and the students' daily energy adequacy levels. Statistical decisions were based on a significance level of $p < 0.05$.

Results

The respondent characteristics provide an overview of the demographic profile of the MAN 2 Parepare City students sampled in this study. The characteristics examined include age, gender, and baseline nutritional status based on the Body Mass Index-for-Age (BMI-for-Age) index. All data were collected from 122 Grade XI students actively participating in the Free Nutritious Meal (MBG) program.

Table 2 Demographic characteristics and nutritional status of respondents

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
15	48	39.3
16	66	54.1
17	8	6.6
Gender		
Male	46	37.7
Female	76	62.3
Nutritional Status (BMI-for-age)		
Thinness	18	14.8
Normal	82	67.2
Overweight	22	18.0
Total	122	100.0

Based on Table 2, the majority of respondents fell into the 16-year-old age group (66 students; 54.1%), followed by the 15-year-old group (48 students; 39.3%), with the smallest proportion being 17-year-olds (8 students; 6.6%). Regarding gender, female respondents dominated the study sample, numbering 76 students (62.3%), while male respondents numbered 46 (37.7%). Meanwhile, nutritional status based on anthropometric measurements (BMI-for-age) showed that the majority of respondents had normal nutritional status (82 students; 67.2%), followed by those classified as overweight (22 students; 18.0%) and underweight (18 students; 14.8%). Univariate analysis was conducted to describe the frequency distribution and percentages of the three main variables in this study: the contribution of energy intake from the Free Nutritious Meal (MBG) program, the overall daily energy adequacy level (accumulated intake from both school and non-school sources), and students' eating habits as assessed via the Food Frequency Questionnaire (FFQ). To simplify data presentation, these three univariate variables have been combined into the single integrated table below.

Table 3 Distribution of main study variables

Variable and Category	Frequency (n)	Percentage (%)
MBG Energy Contribution		
Low (<25% of daily requirements)	61	50.0
Moderate (25%–35% of daily requirements)	59	48.4
High (>35% of daily requirements)	2	1.6
Daily Energy Adequacy Level		
Inadequate (<80% RDA)	27	22.1
Adequate (80%–110% RDA)	93	76.2
Excess (>110% RDA)	2	1.7
Eating Habits		
Low (<50% FFQ score)	17	13.9
Moderate (50%–75% FFQ score)	68	55.8
Good (>75%–100% FFQ score)	37	30.3
Total	122	100

Table 3 shows that regarding the MBG Energy Intake variable, half of the total respondents 61 students (50.0%) fell into the Low intake category. Respondents in the Moderate intake category numbered 59 (48.4%), while only 2 students (1.6%) fell into the High category. Regarding the daily energy adequacy level, the majority of respondents (93 students or 76.2%) achieved an Adequate level of energy adequacy. Respondents with an Inadequate daily energy adequacy level numbered 27 (22.1%), while those with an Excessive level totaled 2 (1.7%). For the eating habits variable, the majority of respondents

(68 students or 55.8%) exhibited Moderate eating habits. Respondents with Good eating habits numbered 37 (30.3%), while those with Poor eating habits totaled 17 (13.9%). Bivariate analysis was employed to examine the relationship between energy intake contributed by the MBG Program and the students' daily energy adequacy levels. Data categorization underwent rigorous verification to ensure consistency in frequency margins between the univariate and bivariate analyses.

Table 4 Relationship between MBG Program Energy Intake and Students' Energy Adequacy Levels

MBG Contribution	Inadequate (n/%)	Adequate (n/%)	Excess (n/%)	Total n (%)	p-value
Low (<25%)	21 (34.4)	39 (63.9)	1 (1.6)	61 (100.0)	0.028
Moderate (25%–35%)	6 (10.2)	52 (88.1)	1 (1.7)	59 (100.0)	
High (>35%)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)	
Total	27 (22.1)	93 (76.2)	2 (1.6)	122 (100.0)	

Based on Table 4, the cross-tabulation results indicate a trend of a positive relationship between the two variables. Among the 61 students in the "Low" MBG energy intake contribution category (<25%), 21 students (34.4%) fell into the "Insufficient" daily energy adequacy category, 39 students (63.9%) into the "Adequate" category, and 1 student (1.6%) into the "Excess" category. In the group of 59 students with a "Moderate" MBG energy intake contribution (25–35%), the proportion of students with "Adequate" daily energy adequacy rose sharply to 52 students (88.1%), while the proportion of students in the "Insufficient" category dropped to just 6 students (10.2%), with 1 student (1.7%) in the "Excess" category. Among the 2 students in the "High" MBG energy intake contribution category (>35%), all (2 students / 100.0%) fell into the "Adequate" energy adequacy category, with no respondents (0.0%) falling into the "Insufficient" or "Excess" categories.

The Chi-Square statistical test results in Table 4 yielded a p-value of 0.028 (less than alpha = 0.05), demonstrating a statistically significant relationship between the energy intake contribution from the MBG Program and the students' daily energy adequacy levels. Objectively, the data distribution reveals a linear pattern in which the increase in energy contribution from the school MBG program is directly proportional to the increase in the percentage of students achieving "Adequate" energy adequacy (rising from 63.9% to 88.1% and 100.0%).

Discussion

The Free Nutritious Meal Program (*Program Makan Bergizi Gratis*, MBG) is a school-based nutrition intervention designed to support the nutritional needs of adolescents at the

senior secondary school level. At this educational level, meeting adolescents' daily energy requirements is highly dynamic because it is influenced by growth and development characteristics, physical activity, and a high degree of autonomy in food choices. The results of this study at MAN 2 Kota Parepare showed that most students had normal nutritional status, accounting for 67.2% (82 students), while the remainder experienced nutritional problems, including *thinness* at 14.8% (18 students) and *overweight* at 18.0% (22 students). These findings reflect the coexistence of undernutrition and overnutrition within the same school population, highlighting the complexity of nutritional problems among Indonesian adolescents. The presence of 18.0% of students with *overweight* and 14.8% with *thinness* emphasizes the importance of balanced and controlled school-based nutrition interventions, such as the MBG Program, to address these nutritional problems simultaneously (9).

For adolescents aged 15–17 years, achieving balanced energy intake is crucial. According to the 2019 Indonesian Recommended Dietary Allowances (RDA/AGK), boys aged 15–18 years require approximately 2,650 kcal of energy per day, whereas girls in the same age group require approximately 2,050 kcal per day. This energy supports rapid linear growth, sexual maturation, and basal metabolism. Inadequate energy intake among school-aged adolescents may affect glucose availability for the brain and consequently contribute to reduced learning focus, physical fatigue, and impaired cognitive function, which may affect students' concentration and academic performance. Therefore, a controlled contribution of energy through the MBG Program at school may help support students' daily energy availability during learning activities (10).

In the context of addressing nutritional problems at MAN 2 Kota Parepare, the MBG Program, which is designed to provide approximately 30–35% of daily energy requirements, has the potential to provide an important nutritional contribution. For students with *thinness* (14.8%), the program may serve as an additional and scheduled source of food intake to support the achievement of adequate daily energy intake. Meanwhile, for students who are *overweight* (18.0%), the controlled energy contribution of MBG is intended to follow balanced nutrition principles. In addition to providing food, the program may provide an opportunity to introduce appropriate portion sizes and healthier food choices, potentially reducing students' reliance on fast food and high-calorie snacks outside school. However, the effects of MBG on body weight and nutritional status should be evaluated longitudinally rather than assumed solely from the provision of one daily meal (11).

The bivariate analysis showed a statistically significant association between the contribution of energy intake from the MBG Program and students' daily energy adequacy ($p = 0.028$). In practical terms, the energy contribution from MBG was adequate for most students (67.2%), indicating that the program may represent an important source of daily energy intake for students. Among students with less optimal dietary habits outside school, the provision of a controlled meal at school may help increase their overall daily energy

intake. However, the statement that every student consumes one-third of their daily nutritional requirements should be interpreted cautiously because the target contribution of MBG does not necessarily indicate that all food provided is fully consumed by every student. Similarly, students with poor dietary habits at home may remain at risk of inadequate energy intake if their total intake from other meals is insufficient (12). Although the MBG Program showed a statistically significant association with daily energy adequacy, this finding requires critical interpretation. The bivariate analysis showed that 100% of students in the high MBG contribution category (>35%) had adequate energy intake. However, the sample size in this category was very small, consisting of only 2 respondents (1.6%). Therefore, the finding that higher MBG contribution is associated with better energy adequacy should not be generalized without considering the small sample size of this subgroup (13).

Another important finding was the presence of 18.0% of students with *overweight* and some students in the low MBG contribution category who nevertheless had excessive energy adequacy (>110% of the RDA). This finding indicates that adolescents' nutritional adequacy is not determined solely by the MBG Program but is also influenced by food consumption outside the school program. Adolescents may be exposed to energy-dense foods and beverages, including ultra-processed foods (*ultra-processed food*/UPF), sweetened beverages, and fast food. These foods are often easily accessible around schools and residential areas. In addition, sedentary behaviors, including low physical activity and high *screen time*, may contribute to positive energy balance and increase the risk of overweight among adolescents, even when they receive a controlled meal at school (14).

Compared with the previous study by Melani et al., which evaluated the effectiveness of a similar school meal program among elementary school children, the intervention challenges differ according to the educational level and characteristics of the study population. Melani et al. reported higher compliance with meal consumption among elementary school children, who tend to receive greater supervision from teachers and parents and have less autonomy in food selection compared with adolescents. Adolescents at the senior secondary school level generally have greater autonomy in choosing and purchasing food, which may influence their overall dietary intake outside the school meal program (15).

This study has several limitations that should be acknowledged to improve future research. First, nutrient intake was assessed using a 24-hour food recall over two non-consecutive days. This method may be subject to recall bias because it depends on respondents' ability to remember their food intake and may not fully capture day-to-day variations in dietary consumption. Therefore, the findings may not completely represent students' long-term dietary intake. Second, the observational analytic design with a *cross-sectional* approach can identify associations between variables at a specific point in time but

cannot establish causal relationships between the MBG Program and students' daily energy adequacy. Nevertheless, this study provides important empirical evidence for evaluating the implementation of a national school-based nutrition intervention among senior secondary school students in an urban area of South Sulawesi.

Conclusion

Based on the data analysis and statistical testing, there was a statistically significant association between the contribution of energy intake from the Free Nutritious Meal Program (MBG) and students' daily energy adequacy at MAN 2 Kota Parepare. The MBG Program provides an important contribution to students' daily energy intake and may help reduce the gap between energy requirements and intake among adolescents during school hours. However, the presence of students with both undernutrition and overnutrition indicates that the effectiveness of the program has limitations when considered as a single nutritional intervention. Optimal daily energy adequacy cannot depend solely on one meal provided at school. It is also influenced by students' food consumption outside school, individual dietary habits, physical activity, and the food environment around their homes and schools.

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